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Report to Congressional Requesters

December 1994

NATIONAL TEST FACILITY

Civilian Agency Use of Supercomputers Not Feasible



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Accounting and Information
Management Division

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The Honorable Ronald V. Dellums
Chairman, Committee on Armed Services
House of Representatives

The Honorable John P. Murtha
Chairman, Subcommittee on Defense
Committee on Appropriations
House of Representatives

The Honorable Sam Nunn
Chairman, Committee on Armed Services
United States Senate

The Honorable Daniel K. Inouye
Chairman, Subcommittee on Defense
Committee on Appropriations
United States Senate

As directed by the House Committee on Armed Services in its report accompanying the National Defense Authorization Act for fiscal year 1995, we reviewed possible civilian agency use of the supercomputing capabilities at the Department of Defense's (DOD) National Test Facility (NTF). We were specifically directed to include, but not limit our study to, using these resources to support (1) the Department of Energy in monitoring oil pipeline leakage, (2) the Department of Education in developing on-line educational software, (3) the Department of Health and Human Services (HHS) in developing an on-line medical imagery repository, (4) the Federal Emergency Management Administration (FEMA) in developing innovative emergency reaction simulations, and (5) the National Oceanic and Atmospheric Administration (NOAA) in climatological modeling.

Results in Brief

Based on our interviews with the civilian agencies cited in the House report, none would be able to make effective use of NTF's excess supercomputing capabilities. These agencies stated they could not use the resources primarily because (1) NTF's supercomputers are older machines whose performance and costs cannot match those of more advanced computers available from other sources and (2) some agencies have not yet developed applications requiring supercomputer capabilities or do not

have funding to support such activities. In addition, future support for the hardware and software at NTF is uncertain, making any investment by an outside user risky.

Background

NTF was designed and constructed in the 1980s to support the Strategic Defense Initiative Organization (SDIO) as the centerpiece for its National Test Bed, a network of research facilities linked together to test and simulate software and, to a lesser extent, hardware that might be used in defending the United States against nuclear ballistic missile attack. SDIO was later reorganized as the Ballistic Missile Defense Organization (BMDO).

Opened in 1990, NTF is a \$123 million government-owned, contractor-operated facility that features a sophisticated, reconfigurable design and extensive network connectivity that give it the potential for conducting large-scale computer operations. Located near Colorado Springs, Colorado, NTF is also a uniquely secure facility that meets DOD's top security requirements.

Although NTF was originally built to house 21 Cray-2 supercomputers to support SDIO activities, only 2 Cray-2s were acquired and installed. The larger supercomputer features four central processors and 512 million words of memory. It is currently running at capacity at the secure classified level, almost totally in support of BMDO needs. A smaller system, featuring two central processors and 128 million words of memory, was turned off last year to save operational and maintenance expenses. When this machine is operating, its maintenance costs up to \$70,000 monthly.

Changes in the world geopolitical situation and the diminished threat of a deliberate Soviet nuclear attack have led to changes in NTF's mission and funding level. The volume of work associated with supporting simulation and testing of missile defense hardware and software has diminished. BMDO funding, which accounted for 89 percent of NTF's budget in fiscal year 1994, has fallen from \$140 million in fiscal year 1993 to \$76.5 million in fiscal year 1994. Fiscal year 1995 funding remains uncertain. Based on the President's budget, NTF anticipates receiving \$52 million in BMDO funding this year.

Faced with such reductions, NTF officials have begun looking for external users to help cover operational costs. Varied services have been offered, ranging from simply leasing secure floor space at NTF to contracting for complete software development and implementation projects. NTF officials

have also proposed restarting the smaller Cray-2 system and selling processing time on it to outside users. Policies and procedures for this service have been developed, but no customers have yet been found.

Scope and Methodology

To identify possible civilian agency use of NTF's supercomputing capabilities, we spoke with responsible program officials at the Ballistic Missile Defense Organization and visited NTF. At NTF we assessed the supercomputer capabilities of the facility and determined what excess capabilities are available to outside users and the costs for using these capabilities. We then interviewed scientific researchers and officials at government laboratories about these capabilities. Finally, we spoke with officials from the relevant programs at the specific civilian agencies cited in the act to ascertain their interest in using NTF's supercomputer resources. The results of our discussions with these agency officials are summarized in appendix I.

We conducted our review between August 1994 and October 1994, in accordance with generally accepted government auditing standards. As requested, we did not obtain DOD's comments on this letter. However, we provided a draft of this letter to NTF's Assistant Deputy for Engineering, who generally agreed with the facts as presented. We have incorporated the Assistant Deputy's views as appropriate.

The Civilian Community Cannot Use Excess NTF Capabilities

Officials from civilian agencies and laboratories we spoke with cited several reasons they would be unable to use NTF's excess supercomputing resources. First, NTF's supercomputers are older machines whose performance and costs cannot match those of more advanced computers available from other sources. Second, some agencies have not yet developed applications requiring supercomputer capabilities or do not have funding to support such activities. Third, because future support for NTF hardware and software is uncertain, any investment by an outside user could be risky.

NTF's Older Supercomputers Are No Longer Competitive

Acquired in the late 1980s, the Cray-2 systems installed at NTF no longer represent state-of-the-art supercomputer technology. For example, the latest Cray supercomputer, the Y-MP C90 system, equipped with 16 processors and 256 million words of memory, can perform at speeds 5 times faster than the Cray-2. Moreover, the latest generation of workstations, such as the IBM RS/6000 590 or the Silicon Graphics TFP,

are far more economical and can almost match the sustained performance of one of the Cray-2's processors.

Because of the Cray-2's processing speed, the \$160 hourly rate NTF proposed for using the system is not competitive with rates charged by other centers for newer, faster supercomputers. In fact, when the rates are expressed in standard terms (that is, price per million instructions per second), the proposed NTF Cray-2 rate turns out to be twice the price several of the National Science Foundation sponsored supercomputing centers—such as the San Diego Supercomputing Center or the National Center for Atmospheric Research—charge for time on their newer and faster Crays.

Supercomputer Funding and Applicability Are Unclear for Some Agencies

Not all the agencies we contacted have the ability to use NTF supercomputer resources, regardless of the desirability of those resources. Agencies such as the Department of Education and FEMA do not have budgets for developing applications to take advantage of the power of a supercomputer. Of all the agencies we visited, we identified only one project, at HHS, that could potentially need supercomputer time. However, this project, the National Library of Medicine's Visible Human Project, will not need access to a supercomputer before 1996.

Future Support and Maintenance for NTF Supercomputers Is Uncertain

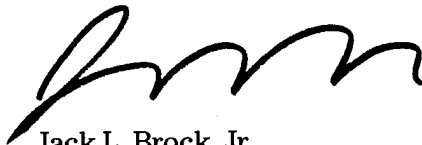
Cray Research, Inc., stopped manufacturing the Cray-2 series supercomputer in 1989. Although the company currently supports and maintains existing Cray-2 systems, there is no assurance that it will continue to do so. Cray has already informed its customers that after September 1996 no new software upgrades will be provided. In addition, hardware maintenance is likely to be difficult or more expensive to obtain after that time.

Future support for NTF's supercomputer resources is further jeopardized by the uncertainty of funding to replace the Cray-2s and to retain the present cadre of talented support staff. The uncertainty surrounding future support and maintenance for NTF supercomputers increases the risks for new users in buying supercomputer time from NTF because they might not realize a full return on the initial investment.

We are sending copies of this letter to the Ranking Minority Members of the House and Senate Committees on Appropriations and the House and

Senate Committees on Armed Services, the Secretary of Defense, the Secretary of the Air Force, the Director of BMDO, and other interested parties. Copies will also be made available to others upon request.

If you or your staffs have questions or wish to discuss the issues in this report further, please contact me at (202) 512-6240 or John de Ferrari, Assistant Director, at (202) 512-6335. Major contributors to this report are listed in appendix II.

A handwritten signature in black ink, appearing to read 'J. Brock, Jr.', with a stylized, cursive script.

Jack L. Brock, Jr.
Director, Information Resource
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Contents

Letter	1
Appendix I Potential Civilian Agency Use of Excess NTF Supercomputing Resources	8
Appendix II Major Contributors to This Report	10

Abbreviations

BMDO	Ballistic Missile Defense Organization
DOD	Department of Defense
DOE	Department of Energy
FEMA	Federal Emergency Management Administration
HHS	Department of Health and Human Services
NOAA	National Oceanic and Atmospheric Administration
NTF	National Test Facility
SDIO	Strategic Defense Initiative Organization

Potential Civilian Agency Use of Excess NTF Supercomputing Resources

Support to the Department of Energy in Monitoring Oil Pipeline Leakage

The Department of Energy (DOE) does not use supercomputers to monitor oil pipeline leakage. Only one program in which DOE participates within the Oil and Gas Exploration and Production Division uses supercomputers—the Natural Gas and Technology Partnership. However, this program is not interested in NTF's supercomputing resources because program officials do not consider the Cray-2 powerful enough for their global climate monitoring simulations, which they currently run on advanced parallel processing machines.

Support to the Department of Education in Developing On-line Educational Software

The Department of Education has no funds to develop educational software to run on supercomputers. Moreover, the Department is just beginning to research how supercomputers could be used as educational tools and has not yet determined what directions are worthwhile pursuing. Since the National Science Foundation funds activities to develop educational applications for supercomputers, the user community looks to them, rather than the Department of Education, for support.

Support to the Department of Health and Human Services in Developing an On-line Medical Imagery Repository

The National Library of Medicine's Visible Human Project is the only HHS project developing a large repository of medical imagery. However, project staff are just now acquiring their first data, which are being stored on a conventional Unix workstation. Supercomputer applications for this project will not be needed until sometime in 1996 when the repository is scheduled to come on-line and HHS is to begin developing algorithms for researchers to view and manipulate the data. At that time, HHS officials said they will first consider using supercomputing resources already available at the National Institutes of Health. If these prove unavailable, they might be interested in using NTF's resources. As noted above, however, hardware and software support to the Cray-2 at NTF will be uncertain after 1996.

Support to FEMA in Developing Innovative Emergency Reaction Simulation

FEMA has neither the funds nor the expertise to develop emergency reaction simulation. They currently contract with the Defense Nuclear Agency to develop disaster models, which FEMA then runs in-house on high-end workstations. The models run effectively on these workstations and do not require a supercomputer.

Support to NOAA in Climatological Modeling

Three NOAA laboratories—the Geophysical Fluid Dynamics Laboratory, the National Meteorological Center, and the Forecasting Systems Laboratory—perform climatological modeling on supercomputers. However, none of these three is interested in using NTF's supercomputers.

The Geophysical Fluid Dynamics Laboratory did not find NTF's proposed price for leasing time on its Cray-2 attractive since the laboratory already has access to a newer, more cost-effective supercomputer—the Cray Y-MP. The National Meteorological Fluid Dynamics Laboratory also found the hourly rate that NTF proposed to be limiting when the costs of software conversion and communications were included. The Forecasting Systems Laboratory already has access to supercomputers and does not have additional funding to lease time elsewhere. Furthermore, laboratory officials are not interested in the Cray-2 because it is an old technology. Instead, they said they would be interested in obtaining access to newer generations of Cray machines, such as the Y-MP C90 or the massively parallel T3D.

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